PROSPECTIVE MEMORY: DEFINING TASKS UNDER TIME CONSTRAINTS

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Dissertation submitted in partial fulfillment of the requirements for the degree of MSc in Business Administration at Católica-Lisbon School of Business & Economics

Thesis written under the supervision of Daniel Fernandes

29-January-2017

ABSTRACT

Title: Prospective Memory: Defining Tasks Under Time Constraints

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Keywords: Prospective, Memory, Time, Periods, Tasks, Age

This dissertation aims to study to what extent time affects consumer's prospective memory. Prospective memory is remembering to carry out intended actions at an appropriate point in the future (Einstein & McDaniel, 2007). For this, a study was conducted where the sample was selected at random as the only variables the researcher was interested in was time, age and consumption tasks. Participants were asked to initially state five tasks, making these their intended actions. These tasks (intended actions) were then stated again after two periods of time; 1-minute and 3-days. Time and age have both been tested by other researchers; however, this thesis details different periods of time in order to obtain the most specific results. The results revealed that prospective memory does indeed worsen with time; nonetheless, they also revealed that age does not affect prospective memory. This result was surprising as research states otherwise. Having consumption or non-consumption tasks also revealed to have no affect, emphasizing that people indeed have poor memory regardless of what their day-to-day prospective memory tasks are. The key take-a-way from this dissertation is that companies should take into consideration that prospective memory affects all their customers. Also, that people are better at predicting an eventual recall after a small pause in time (Dunlosky & Nelson, 1992). In specific, previsions for the 3-day time period were made after the previsions for the 1-minute period. Thus, because there was a pause in time before the 3-day prevision, this caused the latter to be more precise.

RESUMO

Esta dissertação foi realizada com o intuito de perceber como é que o tempo afeta a memória prospetiva dos consumidores. A memória prospetiva acontece quando uma pessoa se lembra de alguma ação que tem de realizar num momento futuro (Einstein e McDaniel, 2007). Assim, realizou-se um estudo em que a amostra foi selecionada aleatoriamente, tendo a investigadora tomado em consideração as variáveis tempo, idade e atos de consumo. Primeiramente foi proposto aos participantes do estudo que indicassem cinco tarefas, assumindo-se estas como as suas ações pretendidas. Depois, foi pedido aos participantes que reescrevessem as suas tarefas em dois intervalos de tempo: 1 minuto e 3 dias. Tendo em conta os resultados foi possível perceber que a memória prospetiva se deteriora com o passar do tempo. Para além disto, os estudos revelaram também que a variável idade não afeta a memória prospetiva contrariando, assim, os resultados obtidos em investigações anteriores. Conclui-se, também, que não há qualquer tipo de diferença na memória prospetiva entre tarefas de consumo ou de não consumo realçando, assim, que a memória é no geral má independentemente de quais sejam as tarefas do dia-a-dia. A conclusão principal desta dissertação é que as empresas, na realização das suas estratégias de marketing, devem ter em devida consideração que a memória prospetiva afeta, por igual, todos os seus clientes. Para além disso, demonstra-se que sempre que se aplica uma pausa temporal a memória torna-se mais precisa (Dunlosky & Nelson, 1992).

ACKNOWLEDGMENTS

First and foremost, I would like to thank my advisor, Daniel Fernandes. Through the ups and downs he truly supported me through it all.

Secondly, I thank Inês Sousa Guedes and Xénia Carvalho for having gone out of their way to help me complete this research the best way possible.

Thirdly, but most important, my family, the ones who have always been there for me. My parents, for being my home wherever they are and my brother, my true best friend for all the laughs.

Lastly, to my friends who shared this journey with me, provided late night talks and to those who didn't, but were there in support and spirit.

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1. INTRODUCTION

Prospective memory is embedded in people's everyday lives. To many companies that profit off of consumer behavior, analyzing prospective memory in their customer's personal and work life is essential.

In an attempt to more precisely measure prospective memory, tasks were listed in order to replicate daily life as much as possible. Common examples of prospective memory tasks in people's daily routines are picking up children from school, a waiter remembering orders when going from table to table or simply picking up bread on the way home (Einstein & McDaniel, 2007). These examples show how prospective memory is essential for the personal and work life. Examples of these involve gaining advantage over their competition by being the brand present in the consumer's prospective memory and preventing a sales loss. In order to analyze this phenomenon, this thesis aims to analyze how time affects prospective memory. In specific, observing how people's prospective memory differs from 1-minute to 3-days' interval taking into consideration various factors, one being the time at which they answered. In order to achieve a broader analysis, the test will be done not only by verifying predictions with results but also by contrasting such time with age.

Another factor that will be tested along with the standard 1-minute and the 3-day time condition, is the difference in time participants took to answer both surveys. With these results, one will be able to analyze the average time participants took to answer the whole survey. As stated further in this research, there is an effect named Delayed Judgments of Learning that states that judgments are much more accurate if made after a small pause in time rather than right after the study is performed (Dunlosky & Nelson, 1992). Hence why we predict that in both H1 and H2, memory accuracy will be higher after 1 minute (the small break indicated in the delayed JOL) rather than in the 3 days.

H1: The average number of remembered tasks in the predicted moment will be higher in the 1-minute rather than in the 3-day condition.

H2: The average number of remembered tasks in the results moment will be higher in the 1-minute rather than in the 3-day condition.

Every-day tasks differentiate from person to person. In order to not only simplify the analysis, but also to be able to link this research to a managerial stand point, the tasks were divided into two sub-categories; consumption tasks and non-consumption tasks. Prospective memory has been analyzed always with time-based and event-based variables. Other studies also analyze action-based. Nonetheless, linking it to the managerial world through consumption tasks has yet to happen. With this research, the aim is to see if people remember more consumption tasks or non-consumption tasks.

Prospective memory is based on retrieval, its simple definition is "the act of remembering to perform an action in the future"(Einstein & McDaniel, 2007). Consequently, the variables age and gender are big giants when people speak about memory loss. Thus, by analyzing not only age separately but also together with the consumption variable, the results can be very interesting not only for companies but to be able to increase studies on prospective memory. The age variable is very interesting to analyze, as according to(Zaval, Li, Johnson, & Elke, 2015), older adults rely more on their crystallized intelligence gained throughout the years. However, in contract, another experiment shows that older adults don't even reach 90% correct when it came to prospective memory tasks (Einstein & McDaniel, 1990).

H3: The higher the age is, the lower the memory will be in both conditions.

H4: The more consumption tasks listed, the lower the memory will be in both conditions.

Fernandes, Puntoni, Osselaer, and Cowley (2016) reveals however that consumer's memories are very fallible, they forget easily, especially if for instance they are shopping without shopping lists as aids for not forgetting. Comparing consumption tasks, such as shopping with memory can aid companies in bettering their consumer service. Although most experiments are conducted in a laboratory, this research was conducted on one of the largest social media platforms; *Facebook*. In

an air traffic control simulation in 2011, it was shown that the more complex the situations are, the better they can provide data for a clearer understanding of prospective memory in certain applied settings (Loft, Shayne, Pearcy, & Remington, 2015). They used this simulation to try to replicate the complicated environment that people are exposed to daily, using the density of their tasks to simulate it. Hence why, the social media platform was chosen, it is the closest one can get to obtaining mass information from participants while they are pursuing their daily routines. Another factor that will be tested and hasn't been used for prospective memory research is the difference in time participants took to answer the surveys. With these results, one will be able to analyze the average time participants took to answer the whole survey, therefore observing this as another time variable. This experiment second handedly shows the behavior of consumers by analyzing what types of tasks they choose to write and in turn this can provide guidelines for company's internal mass restructuration.

2. THEORY FRAMEWORK

In introducing the topic of prospective memory, one has to understand that prospective memory joins a complex array of cognitive processes and the memory in itself (Einstein & McDaniel, 2007). Cognitive processes are tasks that the brain acts upon automatically, they are procedures that process all the information received from the environment (Salazar, CogniFit, 2017). There are various kinds of cognitive processes, the main two are *basic cognitive process* and *high or complex cognitive processes.* The basic processes involve all actions that are within sensation and perception, attention and memory. High processes involve intelligence, thought and language. For the purpose of this research, memory will be highlighted. The part of the brain that hosts the memory is very important. A person has various types of memory (short-term memory, working memory, semantic memory, long-term memory, prospective memory…) and although they all work together, they don't depend on the same brain area. An example of the independent functioning of the brain, is for instance when people who have some form of brain loss such as amnesia still remember how to walk but forget other their partner's name (Salazar, CogniFit, 2017).

Not only are cognitive processes important for everyday functioning, they also help detect what prospective tasks each person has to do. The link between both is essential for prospective memory to thrive and for the successful functioning of one's everyday life. The cognitive process used in prospective memory is what allows consumers to actively retain information that is thrown at them by companies.

Digital marketing is growing exponentially, especially on the largest social network platform; *facebook*. There are 2.789 billion active social media users in the world, these are growing by 21% since January 2016, meaning another 482 million yearly. Advertisers are moving to *Facebook* and *Google* because they know they have the possibility to reach billions of people and have wealthy data, in *facebook*'s case, the company has more than 1.5 billion users, this is much more than any other single media business. Hence why for this experiment, it made sense to deliver the survey through *facebook*. This was the platform that would give the most amount of feedback from the most diverse backgrounds. Since *facebook* is part of most people's everyday lives, it made sense to ask people to state their upcoming tasks through this platform. Companies need to understand how they can differentiate themselves from their competitors, knowing how people's prospective memory works can help achieve that.

As stated in Craven's research about gaining strategic marketing advantage, "marketing strategy helps determine whether a business can survive and grow in today's highly competitive business environment" (Cravens, 1986). The objectives of strategic marketing are to decide the market, it's competitive advantage and when it should enter the market to compete (Salazar, 2017). Prospective memory can once again aid in discovering when firms should enter the market and how often they should launch their advertising.

3. LITERATURE REVIEW

3.1 Retrospective and Prospective Memory

The memory divides itself into two sections; the retrospective memory and the prospective memory. Retrospective memory started to be investigated much sooner than prospective memory.

This memory is based on events that happened in the past, for instance, a movie seen in the past or a sequence of words learnt for a previous experiment past (McDaniel & Einstein, 2007). Meaning that, in retrospective memory, the person tries to answer a request from old episodes from their past (McDaniel & Einstein, 2007), usually with the help of cues and information, or both (Uttl, Miller, Graf, & Tuokko, 2001) Here, researches can clearly identify the issues when creating an experiment; in real life, the retrieval process does not happen from a request to remember (Ebbinghaus, 1964). Contrarily, prospective memory does not have a clear distinction between laboratory and real-life because a request for a memory search happens when in both sections. What happens is, a recollection of the planned action comes to mind without having ever been stimulated. This phenomenon is known to people as "out of the blue" (McDaniel & Einstein, 2007). The link that joins both prospective memory and retrospective memory is seen in the following example; When purchasing groceries on the way home from work. For this, the prospective memory is used in order to remember to complete the activity while driving by the supermarket. However, after this initial remembrance of going to the groceries, the rest of the task becomes retrospective; recollecting items from the grocery list, this activity of recollecting is the same as retrieving works for a recall test (Uttl, Miller, Graf, & Tuokko, 2001).

3.2 Prospective Memory

In order to understand all the previous research that has been done about prospective memory, one has to understand that there is a factor that is impossible to replicate. This being the real-world factors, every day prospective memory tasks usually require one to remember that specific task while doing a parallel action. This makes it hard to recreate the real world factors in a laboratory, creating a problem with being able to properly analyze prospective memory. The solution for this, researchers have found, is using ongoing tests in order to replicate the real-world as much as they can this way making the experiments as real as possible (Einstein & McDaniel, 1995). The ongoing tasks are used to represent all the different factors that are present in people's day to day life, once again reinforcing the "realistic" feel. Once they bring the ongoing tasks in, they then have to add a specific task; the prospective memory task to be tested. McDaniel & Einstein, (2007), describe that there are two ways for the remembering stage to happen. The first is to monitor the environment as a strategic way in the presence of a target event. Secondly, relying on expected environmental conditions to bring in the intended action.

3.3 Ongoing Tasks

Ongoing tasks are actions that are given to participants in experiments in order to "distract" them while they do the prospective memory task that is being tested. These tasks are meant to simulate all the tasks and actions that people are targeted with daily. Einstein, McDaniel, Richardson, Guynn&Cunfer, (1995), conducted a research that aids in the understanding of the role of ongoing tasks. In this specific experiment, researchers wanted to analyze time-based and event-based prospective memory. The ongoing task (to occupy them) was having people answer general-knowledge questions. This occurs in order to prevent that the prospective memory intention is not kept in the working memory (McDaniel & Einstein, 2007). Working memory, as stated by Salthouse, (1994), joins storage and processing, making it the exact opposite of short-term memory. Once the participants were all occupied, they did two distinct steps to distinguish between the event and the time-based analysis. For the event-based, the participants had to press the F8 key whenever the word "president" appeared. For the time-based, participants were told to press the F8 key whenever periods of 5 minutes elapsed. This procedure works as a basis to many prospective memory laboratory experiments.

3.4 Time Based and Event Based

There are two main ways to observe prospective memory; with time-based events or event-based events. In special cases, activity-based events are also used (will be explained further). Event-based prospective memory tasks refer to situations where the action in question is appropriate when an external event happens (Einstein & McDaniel, 1990). An example of such are when one has to buy bread and only remembers when s/he passes by the bakery. In contrast, time-based prospective memory tasks are when the intended action happens after some certain time period has passed or at a specific time during the day (Einstein & McDaniel, 1990).

Although activity and event-based are the norm for analyzing prospective memory, two researchers state that activity-based prospective memory does not require the interruption of ongoing tasks (Kvavilashili & Ellis, 1996). Instead, tasks are signaled before or after the actual activity takes place. An example is taking medication after lunch; this action requires a person to do something in the time gap between lunch and before the next activity starts (McDaniel & Einstein, 2007). However, McDaniel & Einstein (1990), argue that this action of taking medication

still requires an interruption of the normal routine of either driving to work, or walking home. Instead of simply making their way to work, the person has to stop to take their medication therefore interrupting their normal routine. In Kvavilashvili & Ellis, (1996),' experiment this concept also happens, as participants are requested to ask for their watches at the end of the experiment (being an activity-based prospective memory task) (Kliegel et al., 2000), it does however make sense to interrupt the prospective memory task as soon as the last one is completed in order to provide a conclusion to the experiment. All in all, it rests unclear whether interruptions to prospective memory tasks should be present in all activity-based experiments or simply do not happen in some (McDaniel & Einstein, 2007). Hence why most laboratory experiments focus of time and event-based prospective memory. Even so, performing studies in laboratories will never be 100% accurate, with prospective memory there are clear differences between retrospective and prospective memory that researchers have to keep to ensure a well conducted experiment.

3.5 Memory and Age

Aging has many negative aspects associated to it, however, there are many researchers that find that as people age they make better decisions. Kovalchik, Camerer, Grether, Plott& Allman, (2005), reveal an example of such by stating that older adults make more correct assessments of their own knowledge, suggesting that as people age they gain better decision capacity. Zaval, Li, Johnson & Elke, (2015), propose that there are two components that explain the effect of aging on decision making; fluid intelligence and crystalized intelligence. Fluid intelligence is being able to transform different types of new information in real time. Salthouse, (2010), & Schaie, (1993), state that many observations of adults from different ages show that a range of cognitive capabilities linked to fluid intelligence decline firmly through the life span of adults. These include task performances involving memory and processing speed. However, if there is in fact a decline in fluid intelligence throughout the years, nearly linearly with age (Salthouse, 2004, 2010), then how do adults still continue to make good decisions. This happens because older adults rely more on their crystallized intelligence.

Crystallized intelligence relies on intelligence that is gained throughout the years through interactions with the environment and prior life experience; experienced-based knowledge (Zaval, Li, Johnson, & Elke, 2015). Meaning that older adults have much more accumulation of practical

experience, they have dealt with many more challenges and have performed various tasks in their everyday life (Rowley & Slack, 2009). Subsequently, mental capabilities such as predicting performance that relies majorly on accumulated knowledge and experience improve across one's life span (Salthouse, 2004). Linked to predicting performance, (Grossmann et al., 2010) states that crystallized intelligence can also be related to knowing one's own limitation of their knowledge.

Various researchers show that there is a difference between younger and older adults when it comes to intelligence and how their memories work, Li, Weber & Johnson, (2013), established an experiment that revealed the same results. They discovered that younger participants had better results on fluid intelligence measure, however when it came to crystallized intelligence measures they were significantly worse. Older participants contrarily to the young participants, had better results in the crystallized intelligence measures and lower results in the fluid intelligence measures.

Einstein and McDaniel created two experiments to examine aging and prospective memory in a more detailed manner. One of the experiments was built by showing young and old adults with a primary working memory task while at the same time, a prospective time based memory task. The results showed that the results of the younger adults were near perfect score, but when it came to the prospective memory tasks, the older adults never even reached 90 correct (Einstein & McDaniel, 1990). These results are backed up by an experiment that revealed that the speed at which information is achieved is what in fact decreases with age, not the actual encoding of the information (Salthouse T. A., 1994). This can be seen when comparing age to working memory, however, Salthouse, (1994), states that working memory also relies on storage and retrieval to work.

3.6 Consumption Tasks

Prospective memory effects not only people's every day lives, but it also effects businesses' sales. For instance, if a customer forgets to buy milk for breakfast, their punishment will be to go back to the store. Similarly, for businesses, their punishment is a lost sale (D. Fernandes et al, 2016). If one considers shopping as a consumption task, then one can use the study performed by Fernandes, Puntoni, van Osselaer & Cowley, (2006), to show how forgetting is a huge problem for consumers, they have difficulty in identifying their previous needs. In average, they fail to buy

30% of previously identified items (Hui, Huang, Suher, & Inman, 2013).Not only do consumers have bad memory and forgetting is a huge issue, but they are also often very overconfident towards what they know (Alba & Hutchinson, 2000)(Wood & Lynch, 2002). As stated by Fernandes, (2013), this may lead to negative consequences such as processing information less extensively. This same researcher also states that because consumers are overconfident about their memory, it leads to them being less prepared to remember to accept a plan. Going back to the shopping, consumers believe they will remember to buy all the groceries so do not use a shopping list (Fernandes, 2013).

3.7 Delayed JOL

Delayed Judgments of learning is an effect where the judgments of learning (JOL) are much more accurate at predicting an eventual recall when they are made after a small pause in time rather than right after the study (Dunlosky & Nelson, 1992). Dunlosky & Nelson's, (1992), study shows precisely that in order for people to make the most accurate prediction, in this case while studying, people should make a JOL after a short moment instead of right after studying a certain topic.

Apart from delayed judgments of learning, there are also experiments that analyze the judgments of learning in general. A specific study tests online monitoring during studies of participants' item-by-item judgments of learning revealing two findings: the first being that participants can estimate how many items they will remember and secondly they can tell with some accuracy which items they will remember and those they wont (Dunlosky & Nelson, 1994).When observing if recall performance differs from an immediate condition or a 1-week condition, it was seen that the JOL's were well calibrated only for the immediate condition, for the 1-week condition the JOL's were overestimated by 35% (Koriat & Bjork, 2004).

Interestingly, when participants were asked to estimate others recall performance, they did so with extreme accuracy, showing that they possess a clear notion that forgetting happens and at which rate it happens at (Koriat & Bjork, 2004). There are two hypotheses regarding metacognitive judgments in this study above; metacognitive judgments can be based on either one of these two foundations of information; subjective experience or domain-specific knowledge that is retrieved from one's memory. This hypothesis is named: "The Dual-Basis View of Metacognitive

Judgments" (Koriat & Bjork, 2004). The second hypothesis named "Theory-Based Predictions: The Activation of the Notion of Forgetting" states that if the dual-basis hypothesis stands, then the assumption that there are conditions that let participants bring priori knowledge about forgetting when thinking of recall predictions has to be clear. This theory-based judgment hypothesis also claims that people rely on information and beliefs to make an informed guess about one's knowledge (Koriat & Bjork, 2004). These two hypothesis show that memory and JOL is always more accurate after a small period of time has elapsed.

3.8 Memory Metacognition

Memory metacognition is the knowledge people have of being able to monitor and control their own learning and memory processes (Dunlosky & Bjork, 2008). This influences the behavior of people by letting them know whether more study is needed (Nelson & Dunlosky, 1991). Meaning that pessimistic predictions about one's future memory can give way to behavior that happens in order to make sure that memory performance is accurate (Fernandes, 2013). Contrarily, optimistic predictions about future memory trick people into believing that employing strategies to remember more in the future is not necessary (Fernandes, 2013). There is no literature review showing prediction of the future memory, the only researcher that has done this is mentioned above. This researcher states that in order to explore future memory prediction in an accurate manner, one needs to rely on memory aids. The example mentioned is; people's decision to write or not a shopping is list is somehow based on future memory predictions, if one believes they will remember just a few items s/he will more likely write a shopping list (Fernandes, 2013).

3.9 Variety Changes by Time of Day

Studies have shown that people make different choices according to what time of day it is (Gullo, Berger, Etkin, & Bollinger), the suggestion is that the time of day impacts variety-seeking. This same study shows that variety-seeking is lower in the morning, people feel less alert in the morning and usually this only starts increasing between morning and afternoon (Blake, 1967). Not only is this important for prospective memory studies, the fact that people choose differently in the morning and at night has a huge impact for marketing practices (Gullo, Berger, Etkin, & Bollinger). Not only do people's memory change, but their desires do too, if managers took this all into consideration, the way they advertised would be different. Several researchers

(Broniarczyk, Hoyer, & McAlister, 1998) (Kahn, 1995) (McAlister & Pessemier, 1982) (Redden & Hoch, 2009) state that people are influenced by variation from the most normal choices up to the most important decisions. Instead of picking the same thing all the time, people choose many familiar options to then consume later. Many authors state that variety truly affects many aspects of people's lives; post purchase evaluations (Etkin & Sela, 2016) and ordinary tasks. Another aspect that affects people's lives are circadian rhythms; internal biological processes that help regulate processes in the body during a 24-hour-period, allowing them to work and function at different times(Hofstra & de Weerd, 2008). The time of day that these processes happen at can affect the decision, speed and quality (Leone et al, 2017) to ad recall(Dacko S. , 2012). This last process; ad recall has once again a managerial impact, by taking these diurnal variations into consideration.

4. METHODOLOGY

This research uses both a descriptive and a causal (experimental). It is a descriptive research as it is an online survey and is of quantitative nature making it structured and previously planned. We collected a few individual characteristic and demographic measures. The participants have closed categories where they can choose their answers. However, this research also uses some causal research because this experiment aims to understand what the relationship between the variables is. This research was conducted in a quantitative method using an online survey; *Qualtrics*, that went public via a social media platform; *facebook*. In order to conduct this research, a series of concepts were used to achieve the best results possible. Firstly, as the aim of this experiment was to have a broad range of participants, it was not necessary to target a specific sample. In order to collect the largest amount of data, the snowball effect was the data collection technique utilized.

This technique is used when potential participants are hard to find, in theory it is when the recruiter selects some participants (the privileged sample) and then from those the "ball" keeps rolling and gaining more snow (participants) (Glen, 2014). It was an extremely successful way to obtain as many answers as possible because there was a very wide trans-national network logic, allowing the collection of data from various backgrounds. It happens in two steps; the first being the identification of the subjects within the population and the second is asking those subjects to in

turn recruit others. This process happens on repeat and only ends once the recruiter reaches the desired sample size. The privileged sample in this case were the direct friends of the researcher on *facebook* and the rest of the snowball were the friends of those. The data collection happened along a period of one month and four days (November 2nd to October 6th) with continuous efforts of asking people to share the survey via their platforms. The control group was the privileged sample.

As stated previously, most prospective memory experiments are conducted in laboratories, in order to alter this feature. Placing an online survey was the closest way of obtaining the same results in the real-life. By placing it online there was also a low probability that the participants were going to use aids. Lastly, the online social media world allowed the participants to still have other ongoing tasks happening such as ads, or other windows open, generating a more realistic copy of the real world. Since the basis of the survey was to ask people what tasks they had to do in the next three days. This gave an idea of not only what people considered as tasks, but gave room to analyze whether they were consumption or non-consumption. Here, there had to be a clear distinguish of what was considered as consumption and what was not.

Consumption is majorly defined as when something/someone in this case uses up a resource. However, for the sake of simplifying the analysis, a broader description of consumption was made. Any action that received something in return or consumed an outside action, was considered a consumption task. For instance, actions such as cooking, and laundry were all consumption of resources already purchased a priori, meaning they would be post consumption tasks. For the purpose of this research, only immediate consumption tasks were considered.

When taking a look at how the online survey was conducted, it was split into two phases; an online stage where the online survey was implemented and a second phase that although it was also online, it was personally directed. This was where the researcher sent a follow-up email asking the participant to list its original 5 tasks.

4.1 Experimental Design

The experimental design was a 2 (memory: predicted vs. performance) x 2 (time interval: (1-min vs. 3-days) model. Both factors were manipulated within participants.

4.2 Experimental Procedure

The experiment involved two phases. In the first phase, participants listed 5 tasks they intended to perform in the next week, then they predicted how many they would remember. Next, participants answered a few questions and reported how many tasks they could remember. They then predicted how many tasks they would remember 3 days later. After the time interval, they were contacted by email and answered how many tasks they actually remembered. Below, each stage of the experiment is explained in detail.

4.2.1 First Stage

The online questionnaire was made with the purpose of creating a simple survey in order to reduce the amount of participants that would drop out. In addition, to observe what the participants' predictions were for the 1-minute and the 3-day condition. Also, to analyze how their prospective memory was after the 1-minute results. The survey began with a small introduction describing that the information gathered would be using solemnly for this master thesis' research. Following this, there was a small box where participants had to indicate their email address so that the second part of the survey could be followed up to that email. After, the participants were asked to write down five tasks from their everyday life they needed to do in the next seven days. Once they had written down the five tasks, they were asked if they would remember each single task they listed. Due to an option on *Qualtrics*, it was possible to verify the amount of time the participant was on the page. With this, one could determine that it would take 1-minute in order for participants to reach the end of the prediction phase. Once this was over, in order to test the efficacy of prospective memory, the participants were asked to list once again the five tasks they had written 1-minute ago.

Still in the online survey, but the next part of the survey was based on the same format as this initial 1-minute condition. Here, the participants were asked how many tasks they predicted they would remember after 3-days had gone by. Followed by, as in the first condition, a separate question for each task. The survey then ended with demographic questions about the participants in order for the researchers to be able to describe the data sample.

4.2.2 Second Stage

After the online survey was conducted, there was a 3-day interval used before the second part of the experiment was implemented. This because, this thesis is researching how time, in specific 3-days affects one's prospective memory. Emails were sent out to different participants during the one-month data collection period. The three days counted after the participant finished the first part of the online survey. This second part although still online, was no longer a mass directed data collection method; it was specific targeting only one person. All emails were personalized before being sent. In this email, there was a small introduction thanking the participants for their help and their participation in not only the first part of this experiment, but the second as well. Followed by two answers the participants had to answer; how many tasks they remembered and what was the number of tasks they remembered. Although this study was performed at two separate times, the collection of the data happened all at one moment, making it a cross-sectional study.

5. FINDINGS

In order to describe the sample obtained, a descriptive statistics test was performed. Here it can be seen that out of the sample n = 74; 23 were male and 51 were female, the average age was x = 28.93 and the median and the mode were both 24.

For the purpose of the following analysis, the labels in the following tables represent the following; "1-minute" = experiments done in the space of 1 minute, either for the predicted condition of the results condition. "3-days" = experiments done in the space of 3 days, for both the predicted and the results condition. The analysis' were performed separately, at first the 1-minute prediction and results. Secondly, the 3-day prevision and results. After having performed a *paired sample t-test,* one can observe that the mean of the results after 1 min (x = 4.89) is superior to the tasks previsioned (x = 4.43). In this same test, one can verify that the p-value is lower than 0.05 (p = 0.000), confirming that there is indeed a statistically significant difference between the medians of the quantity of the tasks previsioned and the results after 1 minute passed. With this in mind, the next step will be to analyze if there are differences between the previsions of the tasks 3 days before and the results 3 days after in order to study H1 and H2. When conducting once again a

paired sample t-test, it is clear that there is in fact a difference between the medians, in specific that the median of the 3-day prevision (x = 3.99) is lower than the 3-day results (x = 4.03). However, by a very slim quantity, meaning that when one observes the p-value, it is larger than 0.05 indicating that there is no statistically significant difference between the mean of the prevision and the mean of the results after 3-days time.

After discovering the differences between the 1-minute condition and the 3-days condition in general, the research then proceeded to finding if there was any statistically significant difference between the prevision condition and the results condition, in order to prove/disprove hypothesis 1 and 2. In the table 1below, using a paired sample t-test for the prevision condition, it can be seen that the p-value is lower than 0.05 (p = 0.008), this way being able to conclude that there is in fact a statistically significant difference, confirming that there is in fact a difference between the 1-minute prevision and the 3-day prevision results. Furthermore, when one takes the means into consideration, it is seen that the mean for the 1-minute condition (x = 4.43) is in fact higher than the mean for the 3-day condition (x = 3.99), confirming H1; that the average number of remembered tasks in the predicted moment will be higher in the 1-minute rather than in the 3-day condition.

Pair 1 (Prevision)	**X**	**SD**	**P-value**
1 minute	4.43	1.008	
3 days	3.99	1.211	0.008

Table 1 – Paired Samples Test (Prevision)

Continuing in line with the analysis made in table 1 and using the same test, a new analysis was made by creating a new pair with the results condition instead of the prevision condition. As seen in the table below, the p-value is also lower than 0.05 (p = 0.000) making it clear that there is a statistically significant difference between the two time conditions. In addition, when one analyzes the means, it is also clear that once again the mean for the 1-minute condition is higher than the 3-day condition. Making it simple to conclude that H2 is affirmative by stating; that the average number of remembered tasks in the results moment will be higher in the 1-minute rather than in the 3-day condition.

Pair (Results)	X	SD	P-value
1 minute	4.89	0.354	
3 days	4.03	1.110	0.000

Table 2 – Paired Samples Test (Results)

To further analyze these results, it was clear in the 1-minute analysis that there was no difference between the prevision and the results for the male sex as the p-value was greater than 0.05 (x = 0.162). However, the female sex did indeed reveal differences between the prevision and the results in the 1-minute condition having a p-vale of (p = 0.001). Although the sample for the female gender was larger with 51 participants rather than 23, their means were still more statistically different (x = 4.35 and x =4.90) than the mean from the males (x = 4.61 and x = 4.87). Conducting the same analysis but for the 3-days prevision and results, it is clear that for male and female there were no significant differences, seeing as both p-values were larger than 0.05 (x = 0.714, x = 0.588 respectively).

However, when comparing gender with the 1-minute and the 3-days condition, the results said otherwise. In order to deepen the analysis, two multiple linear regressions' will be performed. The dependent variable will be the results variable of the 1-minute and the 3-day condition. The independent variable are the variables being tested to see if they have any correlation with prospective memory. These are; consumption tasks, how long it took for each participant to complete the online data collection with both stages included, what time they answered the first phase, what time they answered the second phase, gender and age.

1 minute Results	Standardized Coef. Beta	t	p-value	R Square
Consumption	-0.007	-0.055	0.956	
Time which finished survey	0.015	0.122	0.903	
Gender	0.042	0.342	0.734	0.003
Age	-0.033	-0.261	0.795	

Table 3 – Multiple Linear Regression (1min)

In table 3, it is clear that none of the independent variables have a statically significant effect on the dependent variable; 1 minute results. All p-values are much larger than 0.05. Similarly, the results are the same in terms of no statistically significant effect between the independent and the dependent variables for the 3-days condition as seen in table 4.

3 days' Results	**Standardized Coef. Beta**	**t**	**p-value**	**R Square**
Consumption	-0.137	-1.129	0.263	0.094
Time which finished survey	-0.025	-0.198	0.844	
Gender	0.210	1.758	0.083	
Age	-0.051	-0.418	0.677	
Time which answered email	0.005	0.039	0.969	
Time it took to answer both phases	-0.183	-1.498	0.139	

Table 4 – Multiple Linear Regression (3 days)

6. CONCLUSION

6.1 Data Discussion

After a thorough analysis of the data collected for this experiment, a variety of conclusions were reached. This experiment was majorly based on finding how time, in specific 1-minute and 3-days affected prospective memory. Additionally, more variables were implemented in order to obtain a larger variable pool. Hypothesis 1 aimed to prove that the average number of remembered tasks in the predicted condition would be higher in the 1-minute rather than in the 3-day condition. One can see that this in fact is proven as $p = 0.008$, meaning that there was in fact a statistically significant difference between the 1-minute condition and the 3-day condition. In order to see if this difference goes along the hypothesis or against it, the mean has to be analyzed. The mean for the 1-minute condition was higher ($x = 4.43$) than the 3-day condition (3.99). Hypothesis 2 wanted to prove the same core feature simply in the 3-day condition; the average number of remembered tasks in the results condition will be higher in the 1-minute rather than in the 3-day condition. This hypothesis is also proven by analyzing that there is a statistically significant difference ($p = 0.000$)

between the 1-minute and the 3-day results condition. In addition, the mean for the 1-minute ($x = 4.89$) is higher than the 3-day condition ($x = 4.03$).

These hypothesis' can both be supported by the delayed JOL phenomenon. This theory states that people will make a more accurate decision when it comes to recalling after a short period of time(Dunlosky & Nelson, 1992). In this case, the 1-minute condition is the short period of time that the participants need in order to make a more precise call. Not only this, but people overestimate how well their memory works (Alba & Hutchinson, 2000)(Wood & Lynch, 2002). As they overestimate, it may lead the participants to process information less extensively making this a negative consequence (Fernandes, 2013). In studies that took place in a 2-week condition and a 6-week condition, there was clear evidence that the recall performance was substantially lower for the 6-week interval than the 2-week interval (Koriat & Bjork, 2004), showing that time had a negative effect on prospective memory.

As age is a very important variable when it comes to memory and in specific, prospective memory, hypothesis 4 aimed to find out if age had an effect on prospective memory. It was clearly shown that age does not have a statistically significant difference on prospective memory on the 1-minute condition ($p = 0.795$) nor on the 3-day condition ($p = 0.677$). Although there are many researchers that state otherwise, the research conducted in this thesis revealed no effect. This can however also be explained by the fact that older and younger adults' memories function in distinctive ways (Zaval, Li, Johnson, & Elke, 2015). Younger adults have better fluid intelligence, this is, knowing how to transform new information in real time into useful insight (Salthouse, 2010) (Schaie, 1993). Older adults on the other hand, have better crystalized intelligence; experience gained throughout the years (Zaval, Li, Johnson, & Elke, 2015). Older adults have lived through more and more years allowing them to have more experience, helping them not only make decisions, but remember correctly.

These two components explain the lack of statistically significant difference between age and prospective memory because even though with age one loses memory, it's only the fluid intelligence part. In compensation, one gains crystalized intelligence. This phenomenon is also revealed in other studies, where it is discovered that the speed at which information is obtained is

what decreases with age, not the actual encoding of the information (Salthouse T. A., 1994). Einstein & McDaniel, (1990), also analyzed age and prospective memory in a more specific way by creating an experiment with a primary working memory task while at the same time, a prospective time based memory task. Here, they discovered that the younger adults had a much better performance than the older adults when it came to the prospective memory task.

The variable that related most to the managerial world were the consumption tasks. These were tested as an independent variable in order to observe if the increase in consumption tasks would influence prospective memory. There was no difference between consumption and non-consumption tasks. The only research specifically stating consumption task was the shopping experience, where for the sake of this analysis, one considers shopping as consumption tasks. Throughout this experiment, the conclusions revealed that not only are people's memory fraudulent, but people get over-confident in thinking that they do not need reminders because they believe their memory will be 100% dependable (Fernandes, Puntoni, Osselaer, and Cowley 2016). Though consumers have a somewhat limited memory and a forgetting probability, they tend to gain over-confidence and as a consequence, their memory tricks them.

Additional variables were tested based on previous research in order to attempt to analyze in further detail what truly impacts prospective memory. A study based on time versus prospective memory revealed that there was no impact of gender in both the results and the prediction condition (Vasconcelos, 2017). These results were tested in this thesis and the results indeed proved this statement; the gender was not statistically significant with the prospective memory condition both in the 1-minute ($x = 0.734$) and in the 3-day results ($x = 0.083$). Even though the theory states that women's minds are more nurturing and men's minds are usually more independent (Golombok & Fivush, 1994), this did not reveal to have any difference when it comes to prospective memory.

Three other variables were tested all related to time; the hour at which the participant completed his/her survey, the hour at which the participant answered the email and lastly the difference of both those times being the total time between both phases of the experiment. The time at which they finished their survey was analyzed both in the 1-minute condition and the 3-day condition. The mean was $x = 10.396$, meaning at 10:24h and in both conditions there was no statistically

significant difference between the average time people took to complete the survey and their prospective memory. The same analysis was made with the average time people took to answer the survey, once again showing no difference and the average time was at 16:06h.

Lastly but still time related, the difference in time between when the participants first started the online survey until when they finished the email was calculated, having an average of 4.13 days. Once again, showed no significant difference. Researchers believe there is a difference when it comes to different times of day, stating that people do make different choices according to what time of day it is (Gullo, Berger, Etkin, & Bollinger). In the morning people feel less alert and this starts increasing between the morning and afternoon (Blake, 1967). However, the results of this research showed otherwise, answering in the morning (x = 10:24h) or in the afternoon (x = 16:06h) showed no statistically significant difference when it came to prospective memory.

6.2 Limitations

There were many variables that led this experiment to not being as accurate as possible. The biggest issue for this experiment was that it was divided into two phases; an online survey phase and a post email response phase. The fact that there were two distinct phases made it hard to make sure all participants completed both phases. The first part was composed of an online questionnaire, here limitations arose by not being able to control participants who gave up half way and did not complete the survey creating attrition. Attrition is when so many people drop out that the results are no longer scientifically significant. High dropout rates make the data collection and trials less believable (Eysenbach, 2005). Also in the first stage, after a short description of the survey's purpose, a blank box was given for people to write their email in order for the researcher to be able to contact them for the second stage of the experiment. It was impossible to make sure people wrote their real emails, so even though there was a mandatory answer option selected, many participants filled in the box simply to be able to move on in the survey, or wrote a fake email. Still in the first stage, there were many participants who did not write either real tasks or repeated the same tasks throughout the five boxes simply to be able to move on.

The limitations increased in the second part of the experiment as this was based on how accurate the participants would write their data in the first phase of the data collection method. As this did

not recurrently happen, there were 3x more emails sent than answers received. The second phase was based on the researcher sending an email asking the participants to list the five tasks they stated 3 days before in order to observe how well their prospective memory was. A very small number of participants replied to those emails, making the sample size substantially smaller. Hence why in this thesis the sample is small, the initial numbers were; n = 435 participants began the survey, n = 206 completed the survey until the end (the first stage) and finally n = 74 replied to the emails sent. The findings obtained from this research are merely a beginning to answering the hypothesis', as a much larger sample would be needed to obtain a more accurate result.

The survey did not have language options; it was solemnly done in English. Although most/all of the connections used on the social media platform speak English, friends of friends did not. As the data collected was majorly based on the snowball effect and the researcher resides in Portugal, the survey reached a wide range of people and should've had Portuguese as a language option. Another limitation is that most of this research is based on experiments performed in labs. Meaning that the results from these experiments will never be as accurate because they are missing the real life factor. When analyzing the memory, a very important part is how consumer's minds are constantly being targeted by various outside stimulus from people's everyday lives, this is biased in the lab experiments. Therefore, the information gathered from lab experiments will not be parallel to experiments conducted in the real life. However, one cannot control this factor.

6.3 Managerial Relevance and Future Research

Studying prospective memory could be more beneficial for companies than they reckon it to be. If a customer's prospective memory fails, it is more dramatic for the business than the customer. This because, if for instance the customer forgets to purchase milk on the way home, he/she will just have to leave the house again and purchase milk, however this might be a different grocery store near by or another brand. For the business, this impacts them directly as their punishment will be a lost sale (D. Fernandes et al, 2016).

It is important for businesses to know that people remember more after 1-minute than after 3-days. This is good for advertisements, to know when to launch a campaign and how often people should be targeted with it. Although both hypothesis 1 and 2 were proven; memory is more accurate after

a short period of time. Further research could be done in order to find out when the delayed JOL begins and when it ends in terms of time. With this, one can then see when memory starts to decay and after how much time it plateaus. It is common to everyone that as time passes, memory decreases, however, in a recent study, various times were observed, but they only analyzed until 1 hour because they stated that the highest rates of decrease in memory were usually observed at the beginning and by the end the decrease rates would slow down and eventually level up (Vasconcelos, 2017). Once again never finding when the JOL becomes accurate and when it starts becoming inaccurate.

This experiment was based on how time affected prospective memory in general, meaning that the demographic information was not taken into consideration. For future reference, this information could be used as a variable to see if it influences prospective memory. This study was different from previous research because it was not performed in a closed environment such as laboratories. Nevertheless, it was not perfect either. For instance, there was no way one could've stopped people from using reminders nor to see what environment they answered the survey in. Also, a larger sample would be needed to make these results significant, as when the data sample is low, the p-value fluctuates along with it. For future research, this experiment would have to be done with more participants to be able to obtain more specific results.

7. APPENDIX

7.2 Appendix 1: Online questionnaire

Thank you for sparing your time doing this questionnaire.
This study is about the completion of tasks, so in order for me to conclude my research, I will be sending you an an email in three days' time with one simple question. The email will come from my personal email (ritapdlopes@yahoo.com) please answer as soon as you receive the email.
I hope I can count on you for the second part of this research.
Thank you once again.

1- What is your email address?

2- Please list 5 tasks you have to complete in the next seven days.
   Task 1____
   Task 2____
   Task 3____
   Task 4____
   Task 5____

3- How many tasks will you remember 1 minute from now?
   0
   1
   2
   3
   4
   5

4- Will you remember this task: (task 1)?

5- Will you remember this task: (task 1)?

6- Will you remember this task: (task 1)?

7- Will you remember this task: (task 1)?

8- Will you remember this task: (task 1)?

9- Please list the 5 tasks you previously stated

Task 1____

Task 2____

Task 3____

Task 4____

Task 5____

10- How many of the tasks that you previously listed did you remember?

0

1

2

3

4

5

11- How many tasks will you remember 3 days from now?

12- What is your gender?

____Male

____Female

13- What is you age?

Thank you for your time, the follow-up email will be sent in 3 days.

7.3 Appendix 2: Paired Sample T-Tests

3 days	**X**	**SD**	**p-value**
Prevision	3.986	1.211	.778
Results	4.027	1.110	

Table 1 – Paired Sample T-test 3-day condition

1 minute	**X**	**SD**	**p-value**
Prevision	4.432	1.008	.000
Results	4.892	.354	

Table 2 – Paired Sample T-test 1-minute condition

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